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Diversity Of Land Snails In Some Residential Areas Of Jabalpur (M.P.)

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Abstract

'Present study was conducted from January 2013 to December, 13 in two distant residential areas of Jabalpur *i.e.* in Ashoknagar, Adhartal, & Gorakhpur (Near Police Station) on amphibious snails. The present paper deals with diversity of amphibious snails also known as "Land Operculates" found in Gardens, drainages, water tanks, garages & even the road sides. Findings reveal maximum diversity & growth during summer & monsoon season & minimum density in winter.

Key Words: Amphibious Snails, Land Operculates, Diversity.

Pages:3 References: 08

INTRODUCTION

Land snails account for around 30,000 of the estimated 1,50,000 member of the Phylum Mollusca (Abott,1989).They form an integral constituent of the soil/leaf litter ecosystem playing an important role in nutrient recycling(Mavinkurve *et.al.*, 2004).

Land snail's are terrestrial gastropod mollusca that have shells.

Gastropods are divided into 3 orders -

1. Ctenobranchiata
2. Pulmonata &
3. Aspidobranchiata

The ctenobranchiata & Aspidobranchiata are called "*Operculate gastropods*" as their foot has an opercular plate which is not found in pulmonates. Generally, the whole phylum mellusca is essentially an aquatic group of animals. Nevertheless, some of the Molluscs like "Land operculates" have made brave attempts to be free from their aquatic medium. Even so, like all amphibious creatures they have to remain forever in the close vicinity of water. So they abound in the habitats, where not only the moisture is very high, but also their skin is frequently bathed by water drops, as available in such humid & wet environments. Therefore much of these forms are generally found in gardens, parks and near drainages (Tonapi, 1980).

A perusal of literature shows a paucity of information on several aspects of these molluscs of India (Rao, 1989) & in Jammu and Kashmir, Kaul *et.al.*, (1980) & Duda & Verma (1995), Verma & Duda (1996) & Duda *et.al.*, 1999 & on western Ghats Mavinkuruve *et.al.*, (2004), Madhaystha *et.al.*, (2004), Arvind *et.al.*, (2005).

MATERIAL & METHODS

Movements and diversity of snails were observed 3 times daily from January'13 to December'13 in Ashok Nagar, Adhartal and Gorakhpur (area near police station).

It was observed that all these creatures come out of burrows, drainages, temples (situated in the Gardens of Houses) old wells, near water tanks, Gardens, garages, roadsides (near drainages) & even in kitchen sinks, water pipes etc.

The systematic identification of these snails has been done after Edmondson (1959) & Rao (1989) & Tonapi (1980). & With the help of ZSI, Jabalpur.

RESULTS AND DISCUSSION

Seasonal variations in terrestrial gastropod population during 12 months of the year were subjected in the present study. The species *Macrochlamys-indica* belongs to family Ariophaphantidae found both in Adhartal and Gorakhpur, Jabalpur. Achatina (*lissachatina*) fulica-fulica belongs to family - Achatinidae. order – Stylommatophora found only in Gorakhpur Jabalpur.

Highest diversity was recorded in August - September, 2013 in the Garden & lowest density was observed in December - January 13. Some snails have seen to hibernate during winter and some have seen to aestivate. Majority of snails were found dead in winter may be because they were not able to hibernate.

Land snails are generally herbivorous but some species are omnivorous. Feeding habits of these land snails were also observed of unable to hibernate& it was found that they feed on variety of food i.e. small leaves, stems, soft bank, fruits and vegetables of plants and small dead insects.

Most pulmonate land snails perform courtship behaviour before mating. Courtship is generally observed in the late evenings especially from 7.15 to 10.30 PM.

It is also very interesting to note that these land snails weren't seen before 2003 in these area.They suddenly appear in the bulk from the one corner of Garden in summer and rainy season and later on they vanished during winter season.

There are many unexplored aspects of

Indian Molluscan systematics, taxonomy, bionomics and their role in biocoenose. Only stray researches carried out in isolated places will not produce an integrated picture on molluscan relationship with their biotic communities.

Recent evidence shows that the invertebrates can be more reliable indicators of "hot spots" of high diversity & overall endemism (Moriz *et.al.*, 2001). Land snails are very good indicators of land use changes. (Arvind *et.al.*, 2005) & are among the most severely threatened animals.

It is needless to emphasize the importance of ecological studies on amphibious & fresh water molluscan for their role in agriculture (Achatina), horticulture (opeas, Glessula) & others, which are vectors like Bulimas, Biomphalaria, Lymnea or Planorbis which spread well known pathogens causing schistosomiasis or bilharziasis and many other diseases undetected so far.

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I thank Dr. S. Sambath, Scientist Zoological Survey of India, Jabalpur, for identification of species. I would also like to thanks Sukarn Singh Maini for his help with drafting this research paper.

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Dermatoglyphics in Down's Syndrome

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Abstract

Variation in dermatoglyphics in a population can be a tool to analyze genetic makeup and any deviation is a strong indicative of inherited abnormality or altered genotype. Dermatoglyphic data were obtained from 18 confirmed patients of Down's Syndrome. The data was correlated and compared with 23 normal persons. In Down's Syndrome cases the standard deviation of ATD angle was much higher than the standard deviation in normal persons.

Total finger ridge counts and ATD angle differed significantly from normal persons. Abnormal dermatoglyphic features such as Semian Crease, Sydney Line, Ulnar Loops, very short fingers and finger nails have occurred in most of the patients.

Key Words: ATD angle, Semian Line, Sydney Line, Ulnar loops.

Pages:4 References: 08

INTRODUCTION

Down's Syndrome is the most common genetic disorder caused by chromosomal abnormality. It affects one of out every 800 to 1000 babies. It is a chromosomal condition which is associated with the characteristic facial appearance, weak muscle tone and intellectual disability. Doctors diagnose Down's Syndrome through a number of tests like screening and ultrasound.

Correlation between dermatoglyphic and certain chromosomal abnormalities suggested by Cummins (1939), Turpin and Casper (1945), Penrose (1949, 1963), Uchida (1963), Walker (1957). Some of the 26 significant hand markers for Down's Syndrome known in medical science as a physical minor anomaly such as Semian Crease, Sydney Line, 10 Ulnar Loops, small hands, short fingernails, in-curved very short thumb, Palmer Axial Triradius, an of angle 45 degree or above. But, in general all these individual hand markers can usually be described as harmless body characteristics. Even when “constellations” of two or more of these hand markers are observed in one perspective of the hand, these hand markers should not be recognized as ‘suspicious’, unless both hands display such constellations in two or more perspectives of the hand.

Penrose (1963) presented the first “phantom picture” describing typical hand characteristics for Down’s Syndrome; more detailed “phantom pictures” were presented later by other scientists.

MATERIAL & METHODS

Indian ink-pad method (Fig 1 and Fig 2) is used to take palm prints of normal persons and patients of Down’s Syndrome. ATD angle was drawn by two lines from triradii situated at the base of index and little fingers to the axial triradius. For the purpose of rounding off the angles to the nearest ten degrees, angles greater than 60 degrees were designated as t”, between 50 and 60 degrees as t’, and below 50 degrees as t.

ATD angle in 15 Down’s Syndrome patients of Jabalpur and 45 normal persons was compared, and the standard deviation was calculated (Table 2). A triradius positioned near the center of the palm is termed t”, a triradius positioned at the base of the palm is termed t, and a triradius positioned halfway between these two positions is called t’. For the angles used in this paper, please refer to Table 1 below.

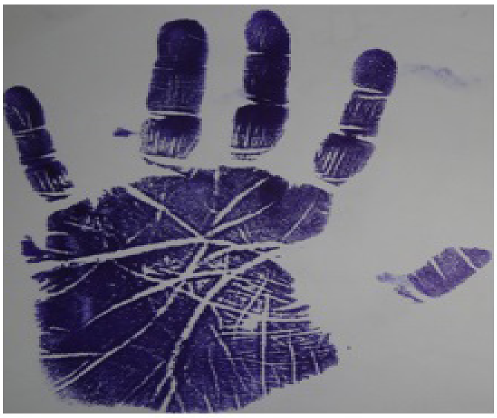


Fig 1: Left Hand

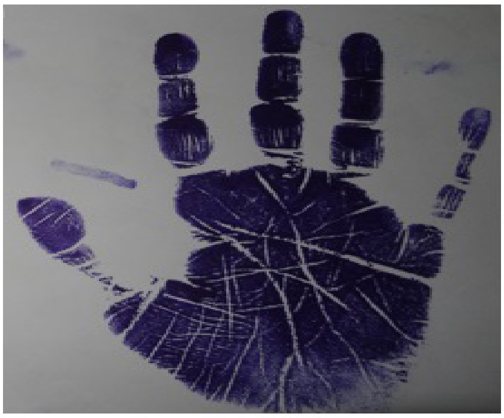


Fig 2: Right Hand

Actual range of ATD angles		Range taken for the purpose of this paper	
Angle	Denotation	Angle	Denotation
>56°	t"	>60°	t"
45°-56°	t'	50°-60°	t'
<45°	T	<50°	t

Table 1: ATD Angle range

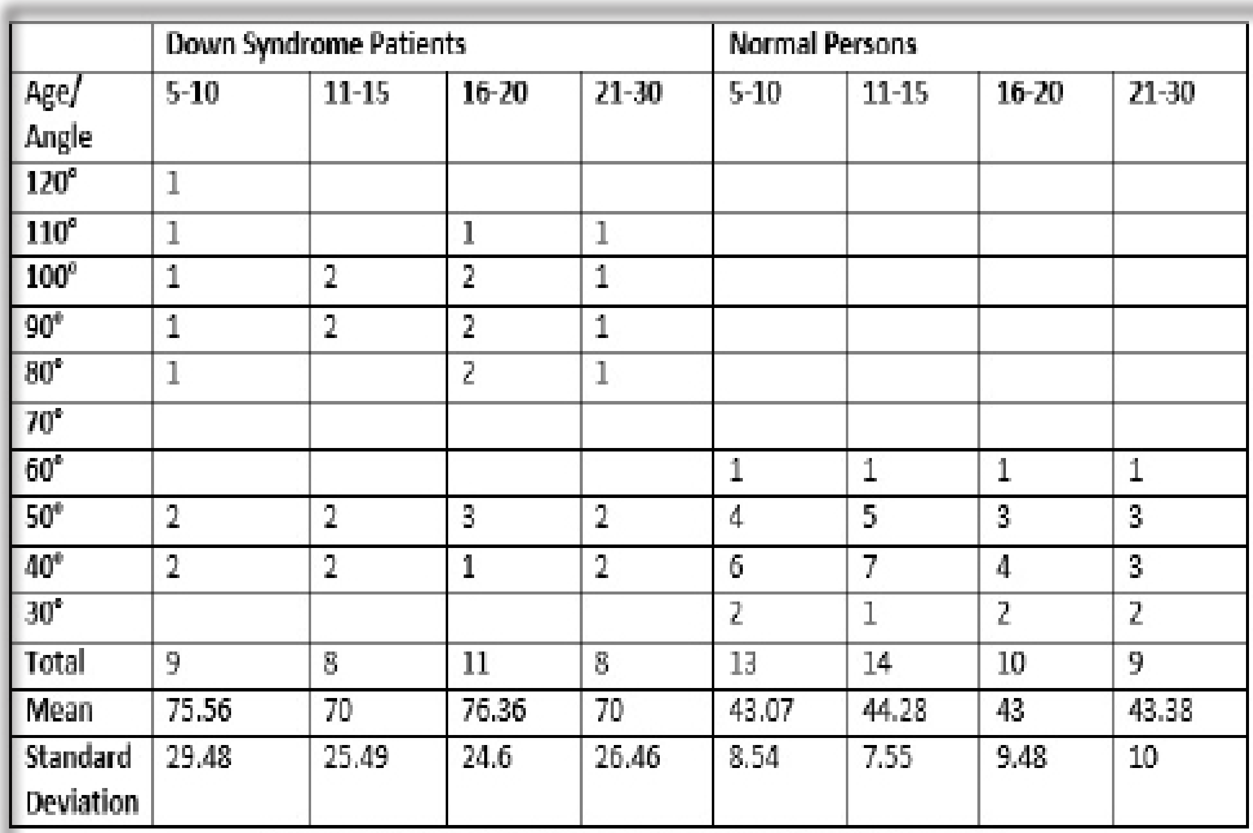
RESULTS AND DISCUSSION

Range of atd angle was towards higher side (t" >= 60 degrees) for the patients of Down Syndrome whereas in normal persons it was towards lower side (t <= 50 degrees). Percentage of t" range was 55.56% in the patients of Down Syndrome & it was 8.7% for normal persons. Frequency of t was 58.7% in normal persons and 19.44% in cases of Down Syndrome (Fig 3).

Dermatoglyphics for Down Syndrome is not used much for clinical diagnosis but these studies can resolve doubts in diagnosis. The significance of dermal configuration, in identification of trisomy 21 was reported by Penrose (1966) & Cummins (1939). Cummins (1939) showed that a centrally located triradius occurs in patients of Down Syndrome with eight times the frequency than in normal persons.

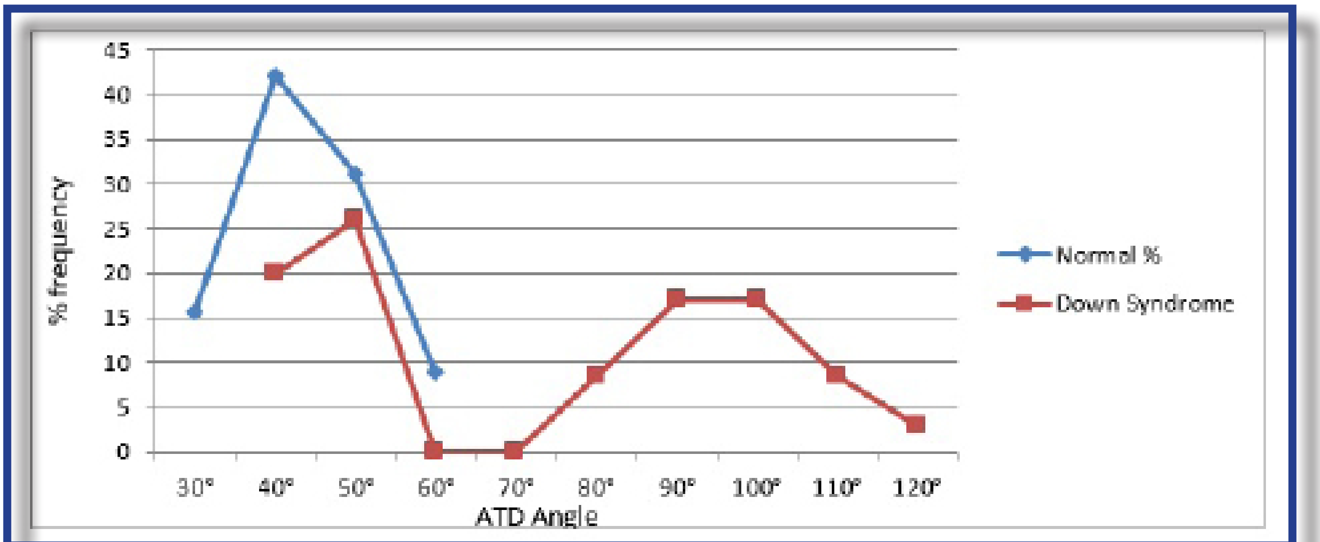
Besides atd angle, other significant hand marks for Down Syndrome patients like Simian Crease, Sydney Line, very short pinky fingers and very short fingernails were also observed.

Dermatoglyphics & the analysis carried out have proved that they are invaluable in their clinical value in selecting patients of Down's Syndrome for cytogenetic analysis; Rajangam S. *et. al.,* (1995). Axial triradii is the most important land mark in the palm to diagnose the Down Syndrome cases (Vashist *et. al.,* 2009).



	Down Syndrome Patients				Normal Persons			
Age/ Angle	5-10	11-15	16-20	21-30	5-10	11-15	16-20	21-30
120°	1							
110°	1		1	1				
100°	1	2	2	1				
90°	1	2	2	1				
80°	1		2	1				
70°								
60°					1	1	1	1
50°	2	2	3	2	4	5	3	3
40°	2	2	1	2	6	7	4	3
30°					2	1	2	2
Total	9	8	11	8	13	14	10	9
Mean	75.56	70	76.36	70	43.07	44.28	43	43.38
Standard Deviation	29.48	25.49	24.6	26.46	8.54	7.55	9.48	10

Table 2: Standard deviation of ATD Angle in different age groups



CONCLUSION & SUGGESTIONS

By these studies, number of people related with patients of Down Syndrome can be benefitted through the development of a faster way to diagnose Down Syndrome.

Awareness Program should be organized for the people related with patients of Down Syndrome by giving clues for diagnosis of this disorder in the form of dermatoglyphics.

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El Nino Impact Of Gujarat Rainfall, India

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Abstract

Ìn this scientific work attempt has been made to quantifying impact of rainfall, different four parts of Gujarat in to relation El Nino and La Nina events occurred used to analyzed 54 years data (1958-2010), the four stations Anand (53 years) of middle Gujarat, Navsari (32 years) of South Gujarat, Junagardh (27 years) of Saurashtra and S. K. Nagar (27 year) of north Gujarat were selected for the study. Out of 54 years of data 18 were El Nino or hot years, 12 were La Nina or cold years and rest 24 were neutral or normal years. The analysis revealed that El Nino and La Nina events surface temperature variation mean TMAX is 34°C, range is 33.2 to 35^{0}C, mean TMIN 19.8°C range 19.4°C to 21.1°C during El Nino and 33°C range 31.1° to 34°C, mean TMIN 19.7°C range 19°C to 20.6°C during La Nina event and mean rainfall during El Nino rear was 871.25 mm with the range of 68-2114 mm, during La Nina mean rainfall is 748.5 mm with range 185-1663mm, neutral year mean rainfall is 977 mm with range 228-2266 mm and mean deviation during El Nina year were 81.8 mm with range of men deviation 8 to 125 mm and deviation percentage is 9.25 with range 5 to 16% during El Nino and La Nina year mean deviation 0.5 mm with range -77 to 148 mm, the deviation percentage is 3.25% with range -9 to 28% and coefficient of variance percent range 18 to 53 during El Nino, 9 to 52 during La Nina and 2 to 33 percent during neutral year in Gujarat. However, there has been large variability from location to location amount of rainfall, deviation over the normal and percent of deviation of rainfall amount mm per year during El Nino and La Nina.

Key Words: El Nino, La Nina, Neutral Year, Surface Temperature, Deviation of Rain Fall, Annual Mean Rainfall, Percent in Deviation, CV% of Rainfall During ENSO.

Pages:13 References: 14

INTRODUCTION

The El Nino Southern Oscillation phenomenon (ENSO) is often through as an irregular inter annual oscillator that swings between warm and cold sea surface temperature (SST) and low pressure over the central and eastern tropical Pacific (Philander 1990). About 80% of the annual rainfall over a large part of Gujarat occurs during the summer monsoon period (June to September), ENSO majority of episodes induce below/above normal rainfall over Gujarat or India. Near the end of each calendar year, ocean surface temperatures warm along the coast and pressure rises. The series of the India summer monsoon rainfall (ISMR) has been devised by Parthasarathy *et. al.,* 1995 and atmospheric phenomenon of southern oscillation measure of difference in atmospheric pressure between the Indian Ocean region and the Pacific region (Venkataraman, 2003). The warmer than average waters were shown to be closely related to a global atmospheric pressure oscillation known as the Southern Oscillation. Kumar *et. al.,* 2012 reported effect of the El Niño Southern Oscillation on the distribution of annual rainfall over the four regions of Gujarat state are investigated using 54 year surface observatory data. Every two to seven time the term El Nino began to be used in reference to these major warm episodes (NOAA 2007). Dai *et. al.,* 1997 found that ENSO is the single largest cause of global extreme precipitation events over land surface. Goddard and Dilley (2005) found that monthly precipitation extremes are not well related to ENSO over tropical land areas as a whole. Curtis *et. al.,* 2007 argue that Goddard and Dilley's (2005) parametric model of the probability distribution function (PDF) of monthly rainfall is inadequate for evaluating extremes and present an alternative methodology that yields a stronger relationship between precipitation extremes and El Nino. Lyon and Barnston (2005) using similar index or SOI to which one used previously by Goddard and Dilley (2005). ENSO is the primary driver of interannual climate and has a large economic and social impact over the globe (Glantz *et. al.,* 1991). Unusually strong warm events raise the question of whether the global warming apparently related to human activities (IPCC, 2001) contributes, or will contribute to the tendency for more frequent El Nino and La Nina events (Trenberth and Hoar 1996). Every two to seven time the term El Nino began to be used in reference to these major warm episodes (NOAA 2007). The increase in gross production of food and cash crops in post independent India has been characterized by neglect of effects of climate on several aspects of crop production resulting in wasteful use input resources (Venkataraman, 2003). The decrease in the rates of crop production even in irrigated area in the last decade of the 20th century indicates the setting in of agricultural non-sustainability with environmental conservation (Venkataraman, 2003). India summer monsoon rainfall shows the large annual variability, it has been shown in a recent analysis of the variation of the Gross Domestic Product (GDP) and monsoon rainfall (Gadgil *et. al.,* 2007). The classification of the El Nino and La Nina year over India on the basis of SOI index which is mention over India map (Fig. 1) where negative value influence the deficit rainfall or monsoon rain received in the country.

MATERIAL & METHODS

This study were carry out four agriculture university of Gujarat state, India by the observed shown in the Table 1, 2 & 3 were class B type surface observatory and twice a day observation taken by observer throughout the year. The station Navsari (Lat. 20^0N57'S; Log. 72^0E54'W; AMSL: 11.9

M), Anand (Lat. 22^0N35'S; Log. 72^0E55'W; AMSL: 45.1 M), Sardarkrushinagar (Lat. 24^0N19'S; Log. 72^0E19'W; AMSL: 154.4 M) and Junagardh (Lat. 21^0N42'S; Log. 702^0E49'W; AMSL: 90 M) shown in the Table 3. In this work attempt has been made to analyze the surface temperature in four stations of Gujarat in relation to ENSO events using 54 years data i.e. Anand of middle Gujarat, Navsari of South Gujarat, Junagardh of Saurashtra and S. K. Nagar of north Gujarat were selected for the study. Out of 54 years of data 18 were El Nino or hot years, 12 were La Nina or cold years and rest 24 were neutral or normal years, Statistical analysis was done to work out annual viz., mean, standard deviation (SD), coefficient of variation (CV%) computed of four station with different event El Nino, La Nina and neutral year data were obtained from *http://www.cru.uea.ac.uk/timo/projpages* and *http://www.bom.gov.au/climate/current.* The India influence the ENSO which declared on the basis of southern oscillation index (SOI) which shown in the India map with SOI impact value with latitude or longitude and give the detail plot of ENSO since 1879 to 2003 with courtesy of NOAA (Fig. 1 and 2).

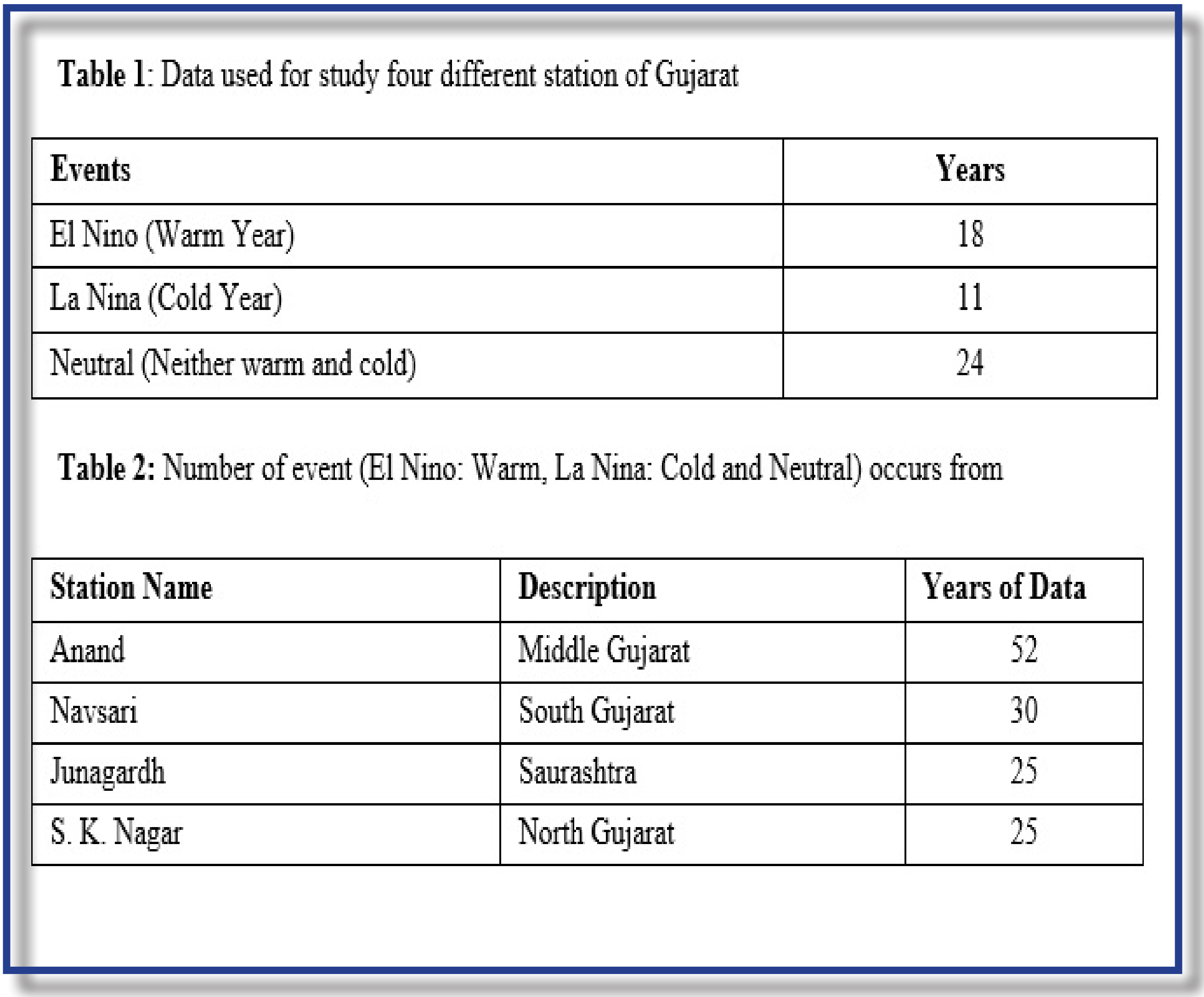


Table 1: Data used for study four different station of Gujarat

Events	**Years**
El Nino (Warm Year)	18
La Nina (Cold Year)	11
Neutral (Neither warm and cold)	24

Table 2: Number of event (El Nino: Warm, La Nina: Cold and Neutral) occurs from

Station Name	**Description**	**Years of Data**
Anand	Middle Gujarat	52
Navsari	South Gujarat	30
Junagardh	Saurashtra	25
S. K. Nagar	North Gujarat	25

Table 3: Four surface observatory location (Agroclimatic zone) of Gujarat state

Surface observatory	Latitude	Longitude	Altitude AMSL(m)	Climate Type
Anand	22.58	72.92	45	Semi Arid
Junagadh	21.52	70.46	61	Semi Arid
Navsari	20.95	72.92	10	Sub Humid
S. K. Nagar	24.32	72.32	154	Arid

Fig. 1: Maps shows the ENSO influence the India (latitudes, longitudes) and SOI values

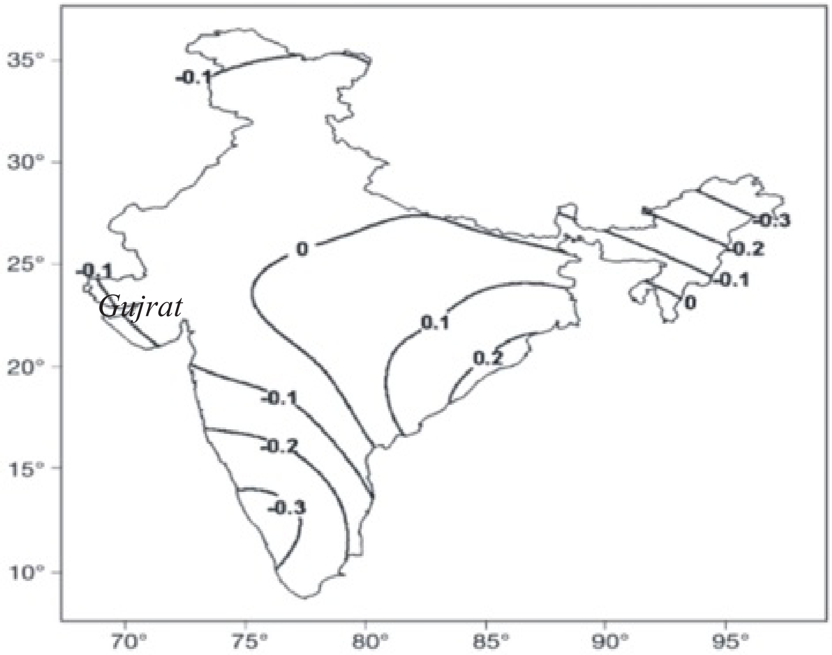
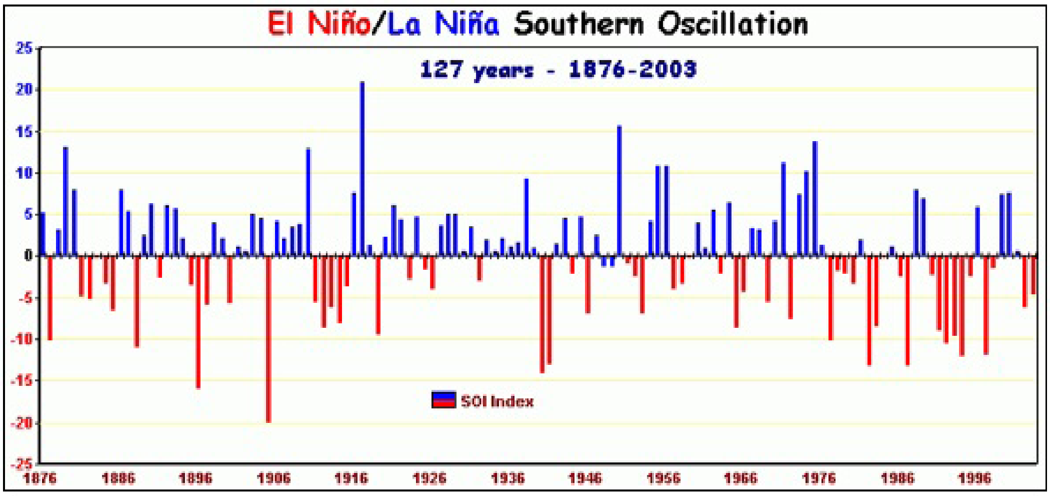


Fig. 2: For a longer-term perspective, here is the Southern Oscillation Index since 1879-2003



Courtesy: National Oceanic and Atmospheric Administration (NOAA).

RESULT AND DISCUSSION

Weather parameters during El Nino and La Nina year

The average value of weather parameters of four stations (Navsari, Anand, S. K. nagar and Junagardh) during the event El Nino years, the results reveal that the bright sunshine hours range were found 7.8 to 9.5 hrs with the mean value is 8.5 of four station during the El Nino year. The rainfall during the event El Nino years were range 404 to 1286 mm with the mean rainfall 768.7 mm per year was received. The maximum temperature (TMAX) range were found 32.9 to 35^{0}C with the mean maximum temperature was 33.8^{0}C and minimum temperature range were 19.4 to 21.1^{0}C with the mean minimum temperature was 20^{0}C during the El Nino year of four station of Gujarat (Table 4). The average value of weather parameters of four stations during the event La Nina years, the results reveal that the bright sunshine hours range were found 8.1 to 9 hrs with the mean value is 8.4 of four station during the El Nino year. The rainfall during the event El Nino years were range 287 to 1518 mm with the mean rainfall 878.7 mm per year was received. The maximum temperature (TMAX) range were found 31.1 to 34^{0}C with the mean maximum temperature (TMIN) was 33^{0}C and minimum temperature range were 19 to 20.6^{0}C with the mean minimum temperature was 18.7^{0}C during the El Nino year of four station of Gujarat (Table 4).

Impact of rainfall during ENSO

The heavy rainfall region of south Gujarat at Navsari the mean rainfall during El Nino years was 1368 mm with range of 956-2114 mm. During the years if La Nina events the mean rainfall was 1225 mm with the range of 1139-1329 mm and during Neutral years the mean rainfall was 1498 mm with range of 722-2266 mm. In middle Gujarat at Anand the mean rainfall during El Nino years was 752 mm with range of 404-1286 mm. During the years of La Nina events the mean rainfall was 879 mm with the range of 432-1633 mm and during Neutral years the mean rainfall was 901 mm with the range of 371-1633 mm. In region of Saurashtra at Junagardh the mean rainfall during El Nino years was 702 mm with range of 142-1320 mm. During the years of La Nina events the mean rainfall was 460 mm with the range of 548-1029 mm and Neutral years the mean rainfall was 950 mm with the range of 431-1293 mm. In north Gujarat at S. K. Nagar the mean rainfall during El Nino years was 663 mm with range of 68-1527 mm, during La Nina events the mean rainfall 430 mm with range of 185-716 mm and during Neutral years the mean rainfall 559 mm with range of 228-1493 mm (Table 5).

Rainfall deviation over normal

In the middle Gujarat at Anand the deviation of rainfall in terms of (mm/year) over the normal during the El Nino Year or warm episode, the results were found that the range of deviation -406 to 479 mm with mean deviation was 62 mm. During the La Nina year the mean deviation of rainfall was -77 mm with the range of -451 to 405 mm and neutral year the mean deviation of rainfall was -141 mm with the range of -400 to 313 mm. The heavy rainfall region of south Gujarat at Navsari the mean deviation of rainfall in terms of mm per year over the normal during the El Nino was 112 mm with the range of deviation

-622 to 862 mm. During the La Nina year the mean deviation of rainfall was -52 mm with the range of -1400 to 781 mm and neutral year the mean deviation of rainfall was -175 mm with the range of -261 to -71 mm. In the region of Saurashtra at Junagardh the mean deviation of rainfall in terms of mm per year over the normal during the El Nino was 125 mm with the range of deviation -363 to 499 mm. During the La Nina year the mean deviation of rainfall was -17 mm with the range of -652 to 739 mm and neutral year the mean deviation of rainfall was -136 mm with the range of -533 to 0 mm. In north Gujarat at S. K. nagar the mean deviation of rainfall in terms of mm per year over the normal during the El Nino was 28 mm with the range of deviation -304 to 962 mm. During the La Nina year the mean deviation of rainfall was 148 mm with the range of -463 to 996 mm and neutral year the mean deviation of rainfall was -102 mm with the range of -346 to 184 mm which shown in the (Table 6, 7 & 8).

Percentage of rainfall deviation over normal

The percentage of rainfall deviation during the ENSO event in the middle Gujarat at Anand the percent deviation of rainfall in terms of (percent per year) over the normal during the El Nino Year or warm episode, the results were found that the range of percent deviation -51 to 181 percent with mean percent deviation was 5 percent. During the La Nina year the mean percent deviation of rainfall was -9 percent with the range of percent deviation -54 to 50 percent and neutral year the mean percent deviation of rainfall was -17 percent with the range of percent deviation -65 to 8. The heavy rainfall region of south Gujarat at Navsari the mean percent deviation of rainfall in terms of over the normal during the El Nino was 8 percent with the range of percent deviation -100 to 56 percent. During the La Nina year the mean percent deviation of rainfall was -4 percent with the range of percent deviation -100 to 56 percent and neutral year the mean percent deviation of rainfall was -12 percent with the range of -12 to -5 percent. In the region of Saurashtra at Junagardh the mean percent deviation of rainfall in terms of percentage over the normal during the El Nino was 16 percent with the range of percent deviation -2 to 63 percent. During the La Nina year the mean percent deviation of rainfall was -2 percent with the range of percent deviation -100 to 66 percent and neutral year the mean percent deviation of rainfall was -17 percent with the range of percent -67 to 30 percent. In north Gujarat at S. K. nagar the mean percent deviation of rainfall in terms of percent over the normal during the El Nino was 5 percent with the range of percent deviation -51 to 181 mm. During the La Nina year the mean percent deviation of rainfall was 28 percent with the range of percent deviation -87 to 187 percent and neutral year the mean percent deviation of rainfall was -19 percent with the range of percent deviation -65 to 35 percent which shown in the (Table 6, 7 & 8).

Percentage of coefficient of variances (CV %) of rainfall during the ENSO

The Percentage of coefficient of variances (CV%) of rainfall during the ENSO event in the middle Gujarat at Anand the CV % of rainfall over the normal during the El Nino Year or warm episode, the results were found that the range of CV% -21 to 84 with mean CV% was 40 percent. During the La Nina year the mean CV% of rainfall was

52 percent with the range of CV% 24 to 92 and neutral year the mean CV% of rainfall was 25 with the range of CV% 10 to 54. The heavy rainfall region of south Gujarat at Navsari the mean CV% of rainfall over the normal during the El Nino was 18 with the range of CV% 8 to 22. During the La Nina year the mean CV% of rainfall was 9 with the range of CV% 8 to 9 and neutral year the mean CV% of rainfall was 26 with the range of CV% 19 to 41. In the region of Saurashtra at Junagardh the mean CV% of rainfall in terms of percentage over the normal during the El Nino was 29 with the range of CV% -3 to 53. During the La Nina year the mean CV% of rainfall was 52 with the range of CV% 32 to 71 and neutral year the mean CV% of rainfall was 20 with the range of CV% 13 to 24. In north Gujarat at S. K. nagar the mean CV% of rainfall in terms of percent over the normal during the El Nino was 53 with the range of CV% -31 to 105. During the La Nina year the mean CV% of rainfall was 40 with the range of CV% 21 to 56 and neutral year the mean CV% of rainfall was 10 with the range of CV% 1 to 32 which shown in the (Table 9, 10 & 11).

CONCLUSIONS

The BSS range were found 8.1 to 9 hrs with the mean value is 8.4, The TMAX range were found 31.1 to 34 ^{0}C with the mean TMIN was 33 ^{0}C and TMIN range were 19 to 20.6 ^{0}C with the mean TMIN was 18.7 ^{0}C during El Nino. Navsari the mean rainfall during El Nino was 1368 mm with range of 956-2114 mm. During the years of La Nina events the mean rainfall was 1225 mm with range of 1139-1329 mm and Neutral years the mean rainfall was 1498 mm with range 722-2266 mm. Anand the mean rainfall during El Nino was 752 mm with range 404-1286 mm. During La Nina events the mean rainfall was 879 mm with the range 432-1633 mm and Neutral years mean rainfall was 901 mm with the range 371-1633 mm. Junagardh, mean rainfall during El Nino was 702 mm with range 142-1320 mm. During La Nina year the mean rainfall was 460 mm with the range of 548-1029 mm and Neutral years the mean rainfall was 950 mm with the range of 431-1293 mm. S. K. Nagar the mean rainfall during El Nino years was 663 mm with range of 68-1527 mm, during La Nina events the mean rainfall 430 mm with range of 185-716 mm and during Neutral years the mean rainfall 559 mm with range 228-1493 mm. Anand range of deviation -406 to 479 mm with mean deviation was 62 mm. During the La Nina mean deviation of rainfall was -77 mm with the range -451 to 405 mm and neutral year mean deviation was -141 mm with the range of -400 to 313 mm. At Navsari, mean deviation of rainfall during the El Nino was 112 mm with the range -622 to 862 mm, during the La Nina year mean deviation was -52 mm with the range of -1400 to 781 mm and neutral year mean deviation of rainfall was -175 mm with the range of -261 to -71 mm, Junagardh the mean deviation of rainfall during El Nino was 125 mm with the range -363 to 499 mm, during the La Nina year mean deviation of rainfall was -17 mm with the range of -652 to 739 mm and neutral year mean deviation of rainfall was -136 mm with range -533 to 0 mm and S. K. Nagar the mean deviation of rainfall during El Nino was 28 mm with the range -304 to 962 mm, the La Nina year mean deviation of rainfall was 148 mm with the range -463 to 996 mm and neutral year mean deviation of rainfall was -102 mm with the range of -346 to 184. The percentage of rainfall deviation during El Nino year at Anand range of percent deviation -51 to 181 percent with mean percent deviation was 5 percent, during the La Nina year mean percent deviation was -9 with the range -54 to 50 percent and neutral year the mean percent deviation was -17 with the range of percent deviation -65 to 8, at Navsari mean percent deviation of rainfall during the El Nino was 8 with the range of percent deviation -100 to 56, during the La Nina year the mean percent deviation of rainfall was -4 percent with range of percent deviation -100 to 56 and neutral year mean percent deviation of rainfall was -12 with the range -12 to -5. Junagardh the mean percent deviation of rainfall during the El Nino was 16 with the range -2 to 63, during the La Nina was -2 with the range of percent deviation -100 to 66 and neutral year was -17 with the range of -67 to 30 percent. In S. K. Nagar, mean percent deviation of rainfall during the El Nino was 5 percent with the range -51 to 181 mm, during the La Nina years mean percent deviation of rainfall was 28 with the range of -87 to 187 and neutral year mean percent deviation was -19 with the range of percent deviation -65 to 35. The CV % at Anand, were found that the range of -21 to 84 with mean was 40 percent. During the La Nina year the mean was 52 with the range 24 to 92 and neutral year the mean was 25 with the range 10 to 54. At Navsari the mean CV% of rainfall over the normal during the El Nino was 18 with the range of CV% 8 to 22. During the La Nina year the mean CV% of rainfall was 9 with the range of CV% 8 to 9 and neutral year the mean CV% of rainfall was 26 with the range of CV% 19 to 41. At Junagardh the mean CV% of rainfall during the El Nino was 29 with the range of CV% -3 to 53. During the La Nina year the mean CV% was 52 with the range 32 to 71 and neutral year the mean was 20 with the range of 13 to 24 and S. K. nagar the mean CV% during the El Nino was 53 with the range of -31 to 105. During the La Nina year the mean CV% was 40 with the range 21 to 56 and neutral year the mean CV% was 10 with the range 1 to 32.

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Table 4: Average value of weather parameter of four stations during the event El Nino and La Nina years

El Nino (Warm episode)					La Nina (Cold episode)				
Year	BSS (hr/day)	RF (mm)	TMAX (^{0}C)	TMIN (^{0}C)	Year	BSS (hr/day)	RF (mm)	TMAX (^{0}C)	TMIN (^{0}C)
1962	8.2	847	34.3	19.6	1964	8.2	593	33.9	19.2
1965	8.7	592	34.2	19.6	1970	8.2	1518	31.9	19.5
1969	8.5	790	33.0	20.1	1971	8.4	854	31.1	20.4
1972	8.6	404	33.2	20.3	1973	8.1	1070	33.3	19.0
1977	8.0	1286	32.9	19.4	1974	8. 6	358	33.6	19.7
1982	8.7	877	33.5	20.5	1975	8.0	1633	32.0	19.6
1987	9.5	434	35.0	20.4	1986	9.0	287	34.0	19.9
1991	8.8	644	33.7	19.5	1996	8.7	898	33.3	19.7
1992	8.7	672	33.7	19.4	1998	8.3	1144	33.5	20.6
1993	8.6	775	34.2	19.9	2000	8.6	432	34.0	19.7
1994	8.4	1237	33.2	19.6	-	-	-	-	-
2002	8.2	478	34.4	20.0	-	-	-	-	-
2004	8.2	866	33.7	19.8	-	-	-	-	-
2006	7.8	1247	33.4	20.5	-	-	-	-	-
2009	8.1	381	34.5	21.1	-	-	-	-	-

Table 5: Analyzed rainfall during El Nino, La Nina and Neutral year (1958-2010)

	El Nino (Warm Year		La Nina (Cold Year)		Neutral	
Station Name	Mean rainfall (mm)	Range(mm)	Mean rainfall (mm)	Range(mm)	Mean rainfall (mm)	Range(mm)
Anand	752	404-1286	879	432-1633	901	371-1633
Navsari	1368	956-2114	1225	1139-1329	1498	722-2266
Junagardh	702	142-1320	460	548-1029	950	431-1293
S.K. Nagar	663	68-1527	430	185-716	559	228-1493

Table 6: The deviation in terms of (mm/year) and percent over the normal during El Nino

El Nino	ANA	NAV	JUG	SKN	NAV	SKN	ANA	JUG
Year	Deviation	Deviation	Deviation	Deviation	%change	%change	%change	%change
1980	-53	129	-	-	9	-	-6	-
1981	195	316	-	-	23	-	24	-
1983	288	809	-	-23	58	-4	35	-
1984	-105	0	-	-139	0	-26	-13	-
1985	-257	-192	-	-269	-14	-51	-31	-
1988	169	862	379	-125	62	-23	20	48
1989	-125	-364	0	75	-26	14	-15	0
1990	401	-150	-13	227	-11	43	48	-2
1995	-274	-146	62	41	-10	8	-33	8
1999	-406	0	-363	-304	0	-57	-49	-46
2001	-122	407	54	52	29	10	-15	7
2003	304	-677	0	-87	-48	-16	37	0
2005	479	-435	335	29	-31	6	58	42
2007	312	453	499	-77	32	-14	38	63
2008	130	663	296	962	47	181	16	37
Average	62	112	125	28	8	5	8	16

ANA: Anand, JUG: Junagardh, NAV: Navsari and SKN: Sardarkrushinagar

Table 7: The deviation in terms of (mm/year) and percent over the normal during La Nina

La Nina	ANA	JUG	NAV	SKN	SKN	NAV	JUG	ANA
Year	Deviation	Deviation	Deviation	Deviation	%change	%change	%change	%change
1982	45		-285	20	4	-20		5
1987	-397	-652	-359	-463	-87	-26	-82	-48
1991	-188	-794	-443	-243	-46	-32	-100	-23
1992	-159	149	715	341	64	51	19	-19
1993	-56	-267	173	93	17	12	-34	-7
1994	405	526	-51	996	187	-4	66	49
1997	-331	79	-200	316	60	-14	10	-40
2002	-353	-256	-314	-326	-61	-22	-32	-43
2004	35	-194	-1400	-97	-18	-100	-24	4
2006	416	450	516	618	116	37	57	50
2009	-451	36	241	-137	-26	17	4	-54
2010	114	739	781	662	125	56	93	14
Average	-77	-17	-52	148	28	-4	-2	-9

Table 8: The deviation (mm/year) and percent over the normal during neutral year

Neutral	ANA	JUG	NAV	SKN	NAV	SKN	JUG	ANA
Year	deviation	deviation	deviation	deviation	%change	%change	%change	%change
1986	-545	-247	-71	-346	-5	-65	-31	-65
1996	67	0	-261	-120	-19	-22	0	8
1998	313	235	-200	184	-14	35	30	38
2000	-400	-533	-167	-125	-12	-24	-67	-48
Average	-141	-136	-175	-102	-12	-19	-17	-17

Table 9: Statistical analysis (SD, CV%) of rainfall during the Hot (El Nino) episode

	Navsari		Anand		Junagardh		S. K. Nagar	
Year	SD	CV%	SD	CV%	SD	CV%	SD	CV%
1982	255	20	213	24	203	51	292	54
1987	260	21	222	51	248	53	315	105
1991	260	22	219	34	210	32	309	76
1992	250	14	229	34	211	24	317	45
1993	374	25	244	31	224	34	325	56
1994	207	15	265	21	225	21	327	32
1997	224	17	251	50	186	22	233	34
2002	239	19	264	55	209	31	220	60
2004	237	19	275	32	213	31	209	43
2006	218	13	354	28	220	22	259	31
2009	126	8	319	84	25	3	208	45
Average	241	18	260	40	198	29	274	53

Table 10: Statistical analysis (SD, CV%) of rainfall during the cold (La Nina) episode year

Navsari			Anand			Junagardh		S. K. Nagar	
Year	SD	CV%	Year	SD	CV%	SD	CV%	SD	CV%
1986	107	8	1986	264	92	227	34	153	43
1996	119	9	1996	239	27	254	32	101	21
1998	107	8	1998	275	24	325	36	257	41
2000	118	9	2000	283	65	377	71	264	56
Average	113	9	-	265	52	265	52	194	40

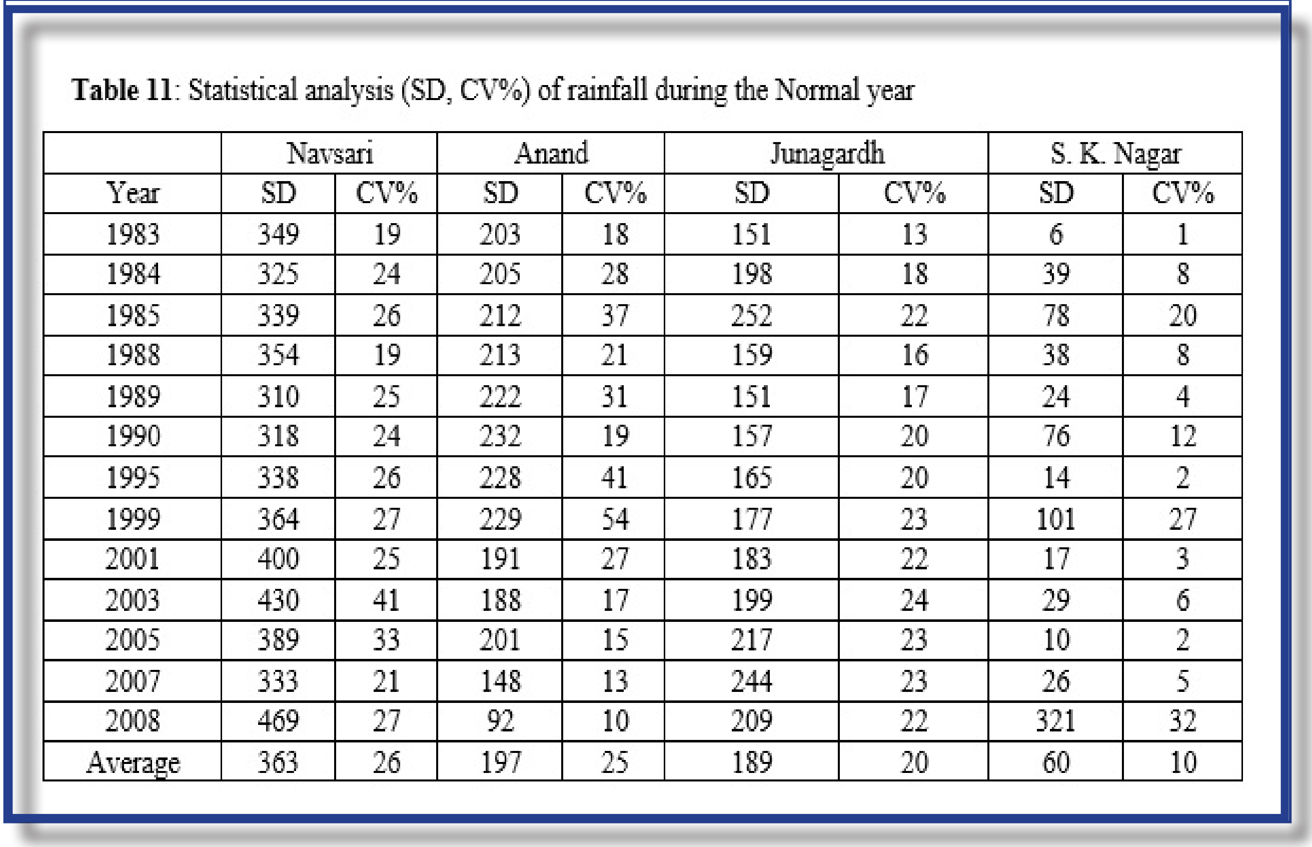

Table 11: Statistical analysis (SD, CV%) of rainfall during the Normal year

	Navsari		Anand		Junagardh		S. K. Nagar	
Year	SD	CV%	SD	CV%	SD	CV%	SD	CV%
1983	349	19	203	18	151	13	6	1
1984	325	24	205	28	198	18	39	8
1985	339	26	212	37	252	22	78	20
1988	354	19	213	21	159	16	38	8
1989	310	25	222	31	151	17	24	4
1990	318	24	232	19	157	20	76	12
1995	338	26	228	41	165	20	14	2
1999	364	27	229	54	177	23	101	27
2001	400	25	191	27	183	22	17	3
2003	430	41	188	17	199	24	29	6
2005	389	33	201	15	217	23	10	2
2007	333	21	148	13	244	23	26	5
2008	469	27	92	10	209	22	321	32
Average	363	26	197	25	189	20	60	10

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Climate Change And Temperature Trends In Coastal Zone Of Odisha During The Period 1990-2009

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Abstract

Òne of the hottest issue of the decade is climate change.Temperature is one of the indicative factors of climate change. In this paper meteorological measurements of the five stations of coastal Odessa namely Paradeep, Puri, Balesore, Chandbali, Gopalpur is analyzed. The maximum, minimum and mean temperature for the period 1990-2009 is taken into consideration. To study variability of climate change the odisha coastal zone is divided into north, central and south coastal zones and the entire year is divided into winter,premonsoon,monsoon and post monsoon to know the variability in temp season wise.

Key Words: Climate Change, Temperature, Maximum Temperature, Minimum Temperature, Meteorological.

Pages:6 References: 03

INTRODUCTION

Earth's linearly averaged surface temperature has increased by 0.74°C during the period 1901-2005 as reported by the latest estimates by the IPCC (2007). The rates of climate change are significantly different among regions (IPCC 2007). According to Hingane, Rupa Kumar and Ramana Murty (1985) during the last century, surface temperature over India has shown a significant increasing trend which is attributed to rise in maximum temperature. Rupa Kumar and Hingane (1988) investigated long-term variations of seasonal and annual surface air temperature at six Indian industrial and non-industrial cities each and have concluded that the non-industrial stations did not show significant trends and there was either a cooling tendency or cessation of warming after the late 1950s at most of the Industrial cities. Thapliyal and Kulshreshtha (1991) study on temperature trends over Indian cities indicates a slight warming trend between 1901 and 1990. Hingane (1996) study estimates rising trends of 0.84 and 1.39 1°C per 100 years in the mean surface temperature calculated for Mumbai and Kolkata, respectively.

Rupa Kumar *et. al.,* (2002) highlighted that the warming trends were visible during all the four seasons in all-India mean surface air temperatures during 1901-2000 from a network of 31 well-distributed representative stations over India. The results showed higher rate of temperature increase during winter (0.04°C/decade) and post-monsoon (0.05°C/decade) seasons compared to that of annual (0.03°C/decade). The variability of minimum and maximum temperature in Poland reveals that the strongest increase in minimum and maximum temperatures occurs in mid and late winter which has been studied by Wibig and Glowicki, (2002). Though beginning of winter and summer indicates decreasing tendencies. Rao, Murty & Joshi (2005) analysed the extreme weather events such as high and low temperatures, heavy rainfall in connection with the climate change over India and concluded that during summer 60-70% of the coastal stations are showing an increasing trend in critical extreme maximum day temperature and increase in night temperatures. Dhodre *et. al.,* (2009) research aimed at quantifying the change in surface air temperature at India's four most populated cities - Delhi, Kolkata, Mumbai and Chennai. While Mondal *et. al.,* study (2012) dealt mainly concerned with the changing trend of rainfall of a river basin of Orissa near the coastal region.

Therefore, this study is proposed to investigate the annual and seasonal temperature trends at five stations in coastal Odisha namely Paradeep,Puri, Chandbali,Gopalpur and Balasore. Our interest also arises to find out whether there is any change in temperature in the coastal zone of Odisha. The study area coastal odisha is in the north-eastern part of the Indian peninsula is located between 17^0 49'N and 22^0 34'N latitudes and 81^0 27'E and 87^0 29'E longitude is potentially vulnerable to climate change.

MATERIAL & METHODS

For this study, monthly mean series of maximum and minimum temperature were obtained from the Indian Meteorological Department, Bhubaneswar, India. From the monthly mean maximum and mean minimum temperature we calculated the monthly mean temperature separately for each month. Accordingly the yearly totals were calculated for each year. From the monthly mean maximum, minimum and mean temperature & coefficient of variation have been computed for each month and each season namely winter, summer, monsoon and post monsoon. For the analysis of winter temperature December, January and February months are considered as these three months record lower temperatures. March, April and May are the months with highest mean maximum temperatures and, therefore, represent the summer season/pre-monsoon. June to august months constitute monsoon season and September, October, November form the post monsoon season. To study the variability of climate change in coastal odisha ,the coastal zone of Odisha is divided into north, central and south zone.the north zone consists of chandbali and Balasore,the central zone comprises of Puri and Paradeep and central zone consists of Gopalpur. Changes in maximum and minimum temperature were examined over these regions.

RESULTS AND DISCUSSION

Station-Wise Temperature

Zone wise mean max. and mean minimum

The figure a represents that there is slight rise in maximum temperature in the North zone compared to south and central zone of coastal Odisha. The figure a indicates a slight rise in minimum temperature in north zone than south zone followed by central zone of the Odisha coastal zone.

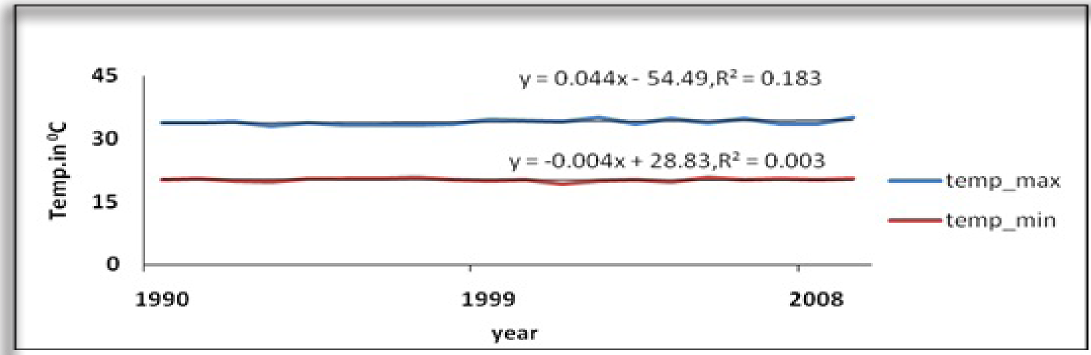

Fig-a Mean maximum and minimum temperature of south odisha coastal zone during 1990-2009.

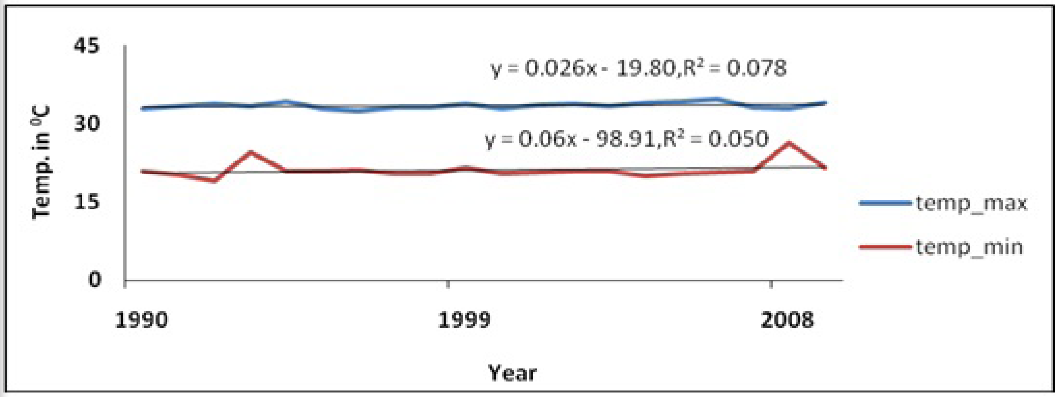

Fig-3 Mean maximum and minimum temperature of Central odisha coastal zone during 1990-2009.

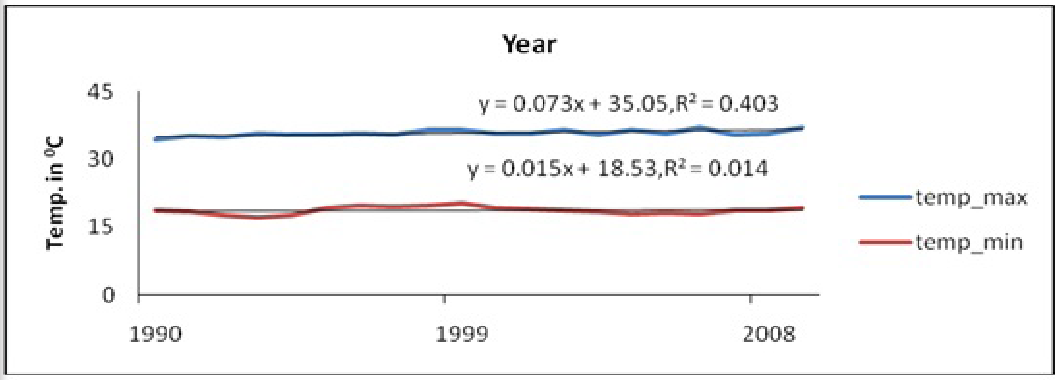

Fig-4 Mean maximum and minimum temperature of North odisha coastal zone during 1990-2009.

Season wise

The graph indicates a slight rise of about 0.54^{0}C in the minimum temperature over the coastal zone during pre-monsoon and a rise of 0.029^{0}C in monsoon fallowed by winter with lowest minimum temperature of 0.079^{0}C.The second point to note is that there is no fluctuation in minimum temperature during post-monsoon i.e. the minimum temperature is 0^{0}C.

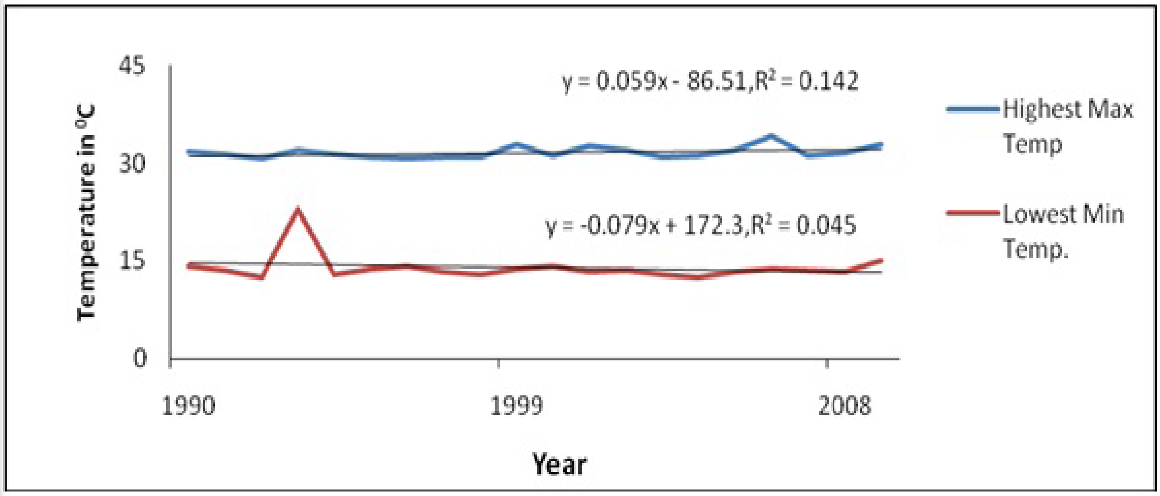

Fig-5 Winter (Dec.jan&feb.) Mean maximum and minimum temperature of coastal odisha during 1990-2009

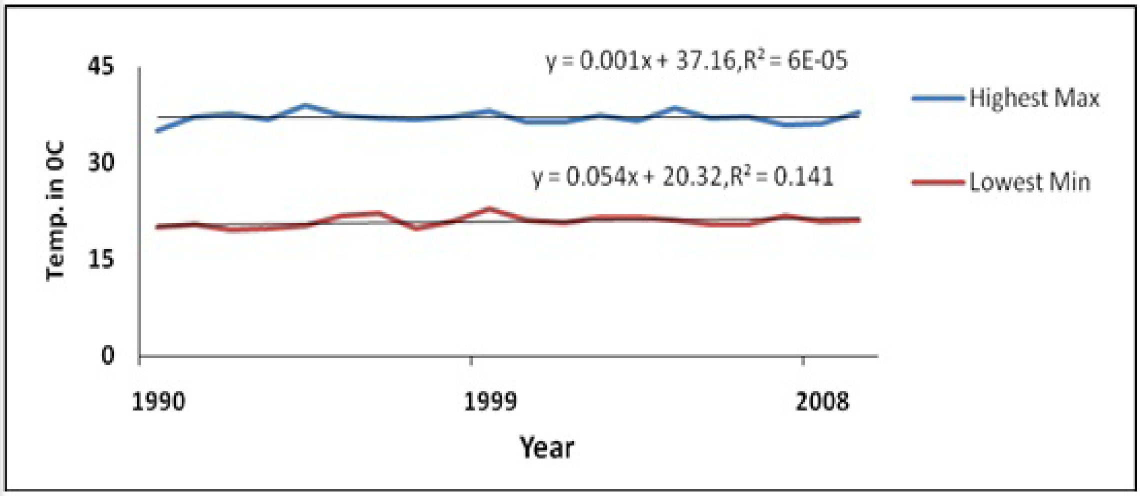

Fig-6: **Pre-Monsoon** (mar,apr &may.) Mean maximum and minimum temperature of coastal odisha during 1990-2009

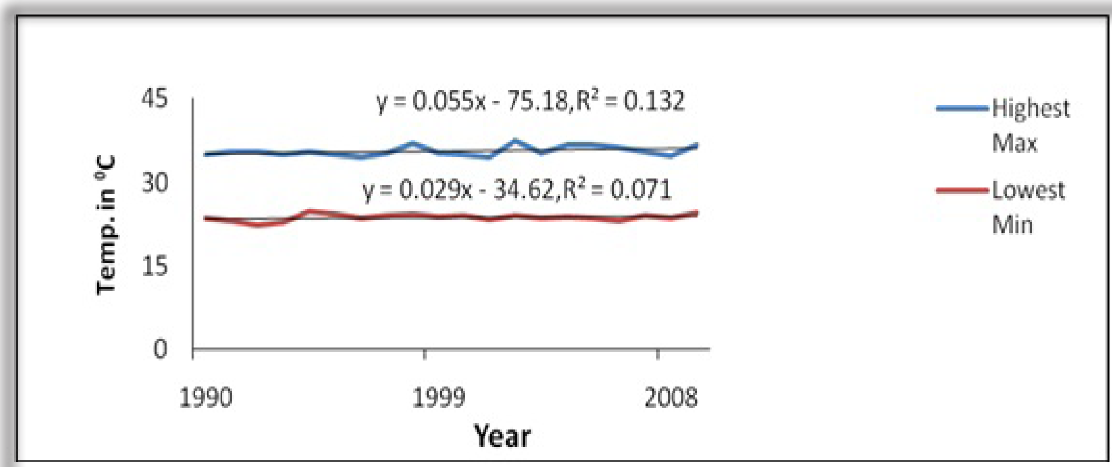

Fig-7: Monsoon (jun,jul&aug) Mean maximum and minimum temperature of coastal odisha during 1990-2009

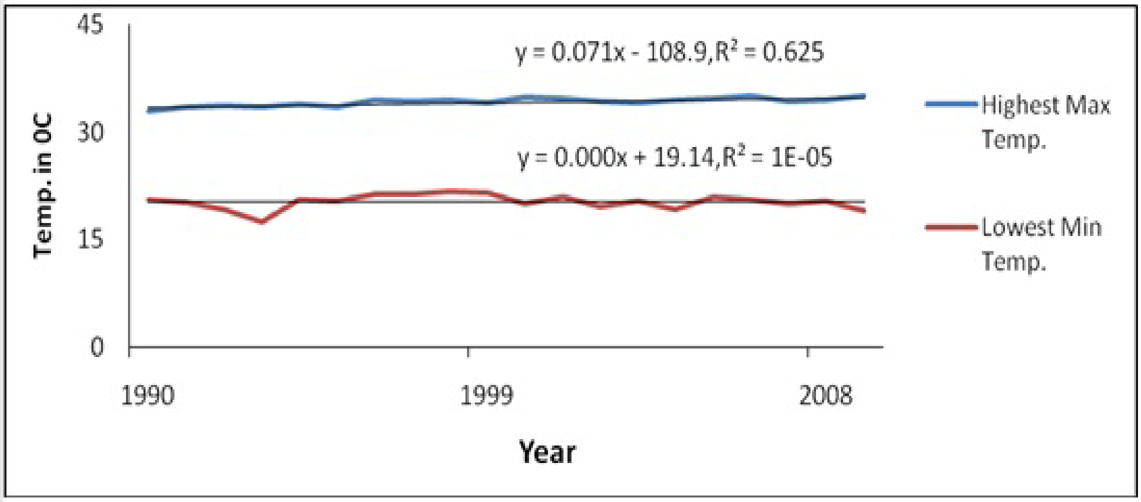

Fig-8:Post-Monsoon (sept,oct&nov) Mean maximum and minimum temperature of coastal odisha during 1990-2009

CONCLUSION

The present study analyzed the temperature data for twenty years 1990-2009 at five stations of coastal Odisha for the determination of the trend of temperature. From the above results it is clear that there is a rise in maximum temperature in the entire coastal zone of Odisha. there is also a slight rise in minimum temperatura rise northern and central part of coastal Odisha except southern Odisha where negative coefficient indicates slight decrease in the minimum temperature. The season wise trend analysis indicates a slight rise in the winter maximum temperature in Odisha coast .The summer minimum temperature is increasing every year by

0.054 ^{0}C .However the winter minimum temperature is decreasing each year but at a very low rate of 0.079 ^{0}C. However the limitations of this works are that the period of 20 years may be regarded as short duration for the determination of trend.

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Bird Diversity in Campus and its Surrounding Area, Jabalpur (Madhya Pradesh), India

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Abstract

ßirds with about 9856 living species play important roles in ecosystem.Twelve percent of bird species were deemed endangered or threatened with extinction by IUCN; 2008 Redlist. The central point of India is located in Jabalpur district and our college campus is situated in central area of the city. City is surrounded by three national parks and many water bodies. In addition good vegetation in and around agricultural fields and human settlements is a characteristic feature of the study area. The present study represent the picture of bird community structure of a small area situated in central part of city. We analysed avian species belonging to ten orders and twenty one families.

Key Words: Abundance, Avifauna Analysis, Community Structure.

Pages:9 References: 11

INTRODUCTION

The rate at which humans are altering the environment has the impacts on biodiversity, many species are already committed to extinction.

Earlier studies on the avifauna of central India are contributed by Ali (1939, 1940) based on collection made in Dhar, Indore, Gwalior and Bhopal, Hewetson(1939) on Betul, Roonwal (1942), on Hoshangabad, Ali and Ripley(1968-1974) Majumdar (1984) There is contribution of Bechler *et. al.*, 1987, Daniels 1989, Joshua and Johnsing(1988) Mattu (2006), Thakur (2010) in this field. But little is known about the birds of thickly populated area of College Campus of Govt. M.H. Collage of Science and Home Science for women and its surroundings area.

MATERIAL AND METHOD

The stratified random sampling technique was followed for studying the birds of each area which involved the division of sites into different strata. These investigation were conducted during different seasons of the years 2013-2014.We also considered and observed the activities & behaviour of the birds. Monitoring the transect area was done in the morning & evening hours as they were most active diving sunrise and before sunset. They were observed with aid of field binocular and photograph were shot with DSC-HX-10V digital still 16X optical zoom, Lens G. Camera.

Birds were identified with help of various grids such as ZSI Jabalpur, followed by Ali and Ripley (1987) and Salim Ali, 2012, The book of Indian birds, Thirteen edition.

RESULT AND DISCUSSION

Present study on bird community of College campus and its surrounding area revealed the presence of 47 species of birds belonging to genera spread over 21 families and 10 orders as observed by us. Further it is interested to note that birds of order- Coraciformes dominated the diversity with nineteen species as identified by us. Family wise analysis showed that family Ardeidae with six species dominated the avifauna of this area followed by Acceipitridae (4 each) Collumbidae, *phasianidae Cuculidae,* passeridae (3 each) Phalacrocoracidae, phasianidae, Alcedinidae, Bucerotidae, Muscicapidae, Muscicapinae, Nectariniidae (2 each) and *podicipedidae Meropidae,* campephagidae Irenidae, Paridae, sturnidae. Dicruridae, corvidale(1 each) in the study area.

Further analysis of relative abundance shows that of 47 species 9 were very common, 27 common, 11 were occasional & uncommon. Of local migrants 4 species were common for 6 months for breeding purpose in the campus area during rainy season. Maximum species of order coraciformes are winter visitors. But some species like pigeon, Dove, Koel, Myna, parakeet, Kingfisher, Indian chat are visible though out the year. The present work is conformity with the earlier work of Chandra k. *et. al.,* (2008) In last few years year some of the common birds like crow, House sparrow, Vulture, Myna decreased and abundance of local migratory birds like Heron, Cormorant, Egret are increased in the study area. Disappearance of vulture, crow, House sparrow from city area & their movement towards outer area is due to the new technologies & life style introduced in the city.

Table I - Systematic list of birds observed in campus and surrounding area of Jabalpur.

S. No.	Taxon.	Scientific Name	Common Name	Res. Status
1.	Order-pelecanifornes	Phalacrocorax niger	Little cormorant	VC, LM(Rn)
2.	Family-phalacrocoracidae.	Phalacrocorax fuscicollis	Indian shag	C
3.	Order-podicipedeformes. F- podicipedidae	Tachybaptus ruficollis	Little Grebe	C
4.	Order-Ciconiiformes	Egretta garzetta	Little egret	VC, LM(Rn)
5.	Family-Ardeidae	Casmerodius albus	Large egret	UC
6.		Mesophoyx intermedia	Median egret	C(LM)
7.		Ardeola grayii	Indian pond Heron	C(LM)
8.		Nycticorax - nycticorax	Black Crowned Night Heron	VC(LM)
9.		Anastomus oscitans	Asian open bill stork	C
10.	Order-Anseriformes	Tadorna ferruginea	Brahminy Shelduck	C
11.	Family-Anatidae	Nettapus coromandelianus	Cotton Teal	C
12.		anus crecca	Common Teal	C
13.	Order-Falconiformes	Milvus migrans	Black Kite	OC
14.	Family-Accipitridae	Elanus caeruteus	Black Shouldered Kite	OC
15.		Accipiter badius	Shikra	UC
16.		Batastur teesa	White Eyed Buzzard	OC
17.	Order-Gruifomes	Grus antigone	Sarus Crane	C

S. No.	Taxon.	Scientific Name	Common Name	Res. Status
18.	Family-Phasianidae	Vanellus Indicus	Red wetted lapwing	UC
19.	Order-Columbiformes	Columba livia	Blue rock Pigeon	VC
20.	Family-Columbidae	Streptopelia senegalensis	Little Brown Dove	VC
21.		Streptopelia orientalis	Oriental turtle dove	C
22.	Order-Galliformes	Gallus gallus	Rod Jungle. fowl	C
23.	Family-Phasianidae	Psittacula eupatria	Alexander parakeet	C
24.		Psittacula krameri	Rose Ringed parakeet	VC
25.	Order- Cuculiformes	Cuculus micropterus	Indian cuckoo	C
26.	Family-cuculidae	Eudynamys scolopacea	Asian koel	VC
27.		Cetropus sinensis	Greater Coucal	C
	Order-coraciformes			
28.	Family-Alcedinidae	Halcyon smyrnesis	White breasted king fisher	C
29.		Alcedo atthis	Small blue kingfisher	C
30.	Family- Meropidae	Merops orientalis	Small bee eater	VC
31.	Family-Bucerotidde	Buceros bicornis	Great pied Hornbill	OC
32.		Ocyceros birostris	Indian grey Hornbill	OC
33.	Family-Irenidae	Aegithina sp.	Common Iora	C
34.	Family-Campephagidae	Pericrocotus cinnamomeus	Small minivet	OC
35.	Family-Muscicapidae	Copsychus saularis	Oriental Magpie Robin	C
36.		Cercomela fusca	Indian Chat	VC(W)

S. No.	Taxon.	Scientific Name	Common Name	Res. Status
37.	Family-Muscicapinae	Cyornis tickellidae	Tickell's Blue Flycatcher	C
38.		Culicicapa Ceylonensis	Grey Headed Flycatcher	C
39.	Family-Paridae	Parus major	Great Tit	C
40.	Family-Nectariniidae	Nectarinia zeylonica	Purple rumped sunbird	C(W)
41.		Aethopyga siparaja	Crimson sunbird	C
42.	Family-Passeridae	Passer domesticus	House Sparrow	VC
43.		Patrornia xanthocollis	Yellow throated sparrow	C
44.		Ploceus Philippinus	Baya weaver	C
45.	Family-Sturnidae	Acridotheres tristis	Common myna	C
46.	Family-dicruridae	Dicrurus Macrocercus	Black Drongo	C(W)
47.	Family-corvidae	Corvus splendens	House Crow	VC

Table Key: Rn=Rainy season, C=common, VC=Very common, OC= occasional, W=Winter visitor, LM=Local Migratory.

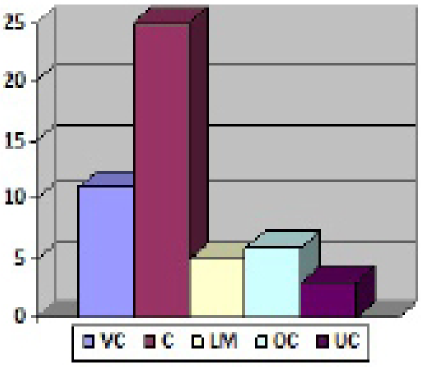
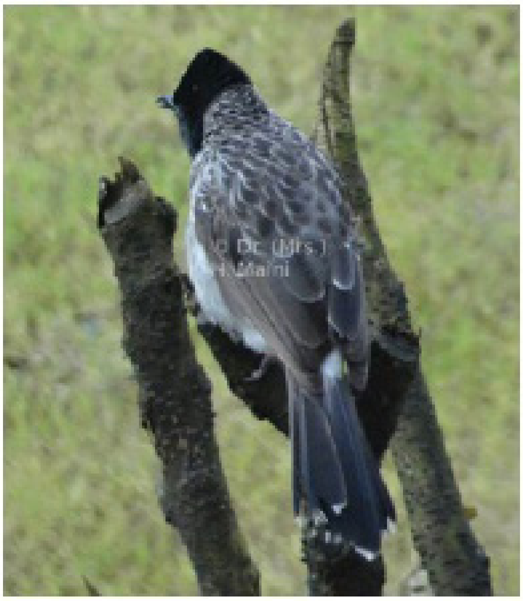


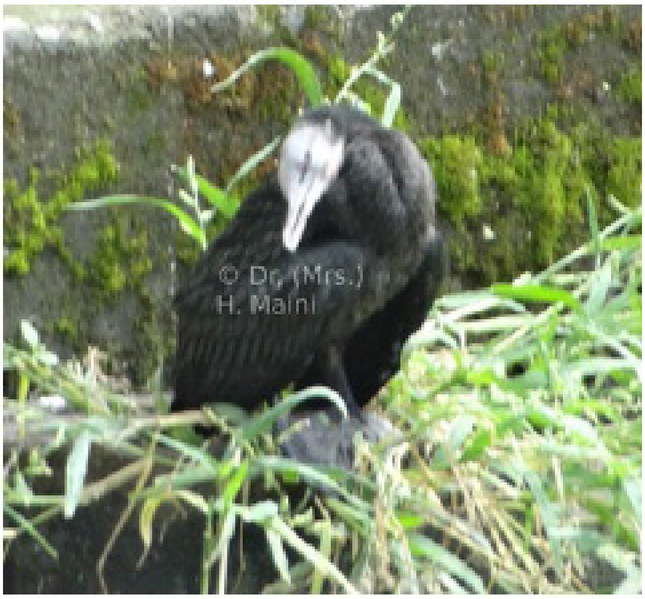
Figure 1: Residential Status of the Birds Observed

Photographs



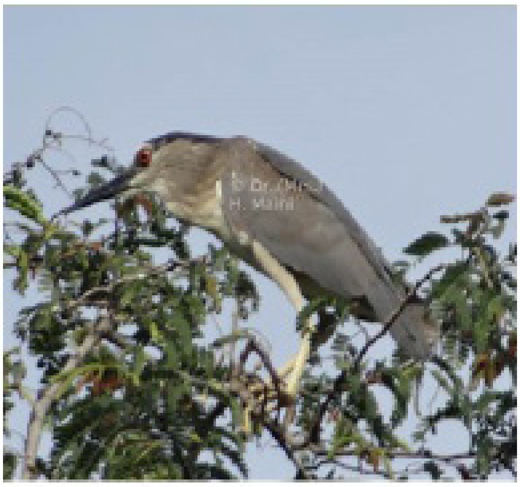
Pycnonotus cafer

(Red Vented Bulbul)



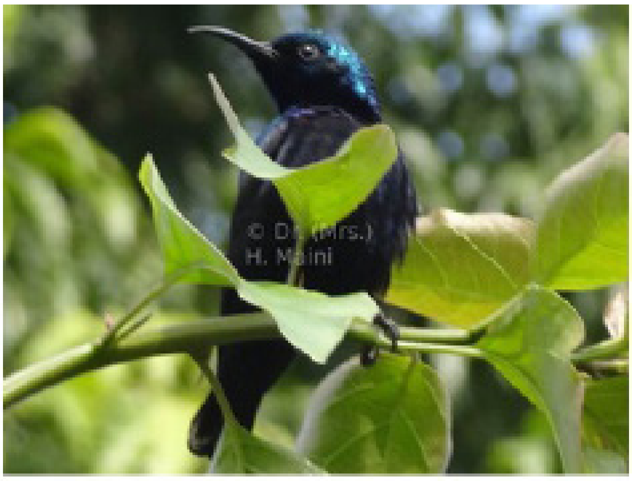
Phalacrocorax niger

(Little Cormorant)



Nycticorax nycticorax

(Black crowned night heron)



Nectarinia asiatica

(Purple Sunbird-male)

Merops orientalis

(Small Bee Eater)

Halcyon smyrnensis

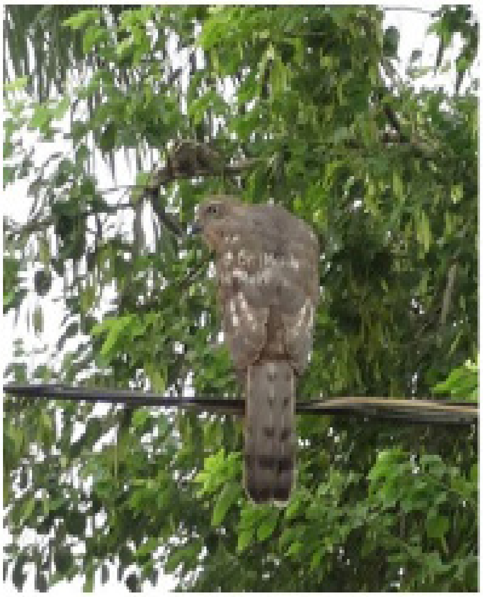
(White-breasted Kingfisher)

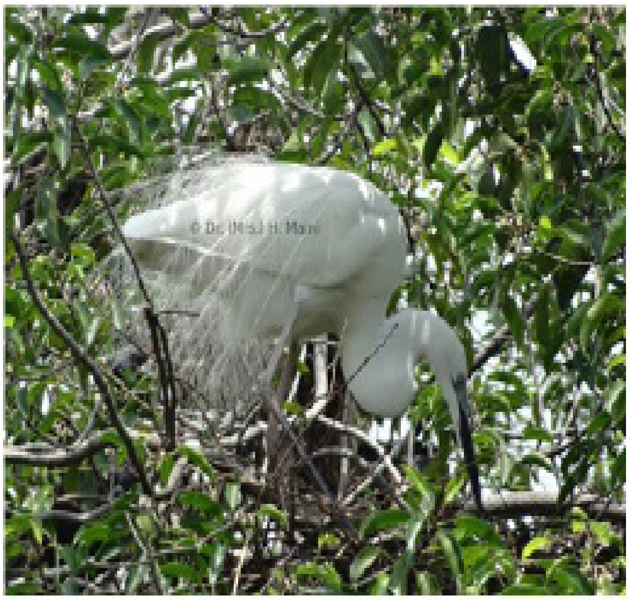
Vanellus indicus

(Red wattled Lapwing)

Buceros bicornis

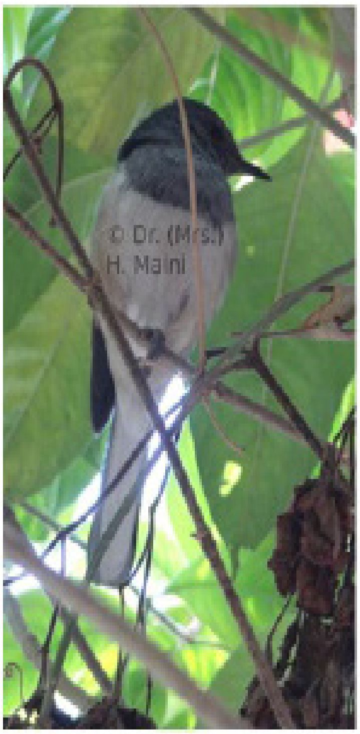
(Great Pied Hornbill)





Accipiter badius (Shikra)

Egretta garzetta (Little Egret)



Copsychus saularis

(Oriental Magpie Robin)

Colony of Little Cormorant

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